THE DENTAL PRACTITIONER

AND DENTAL RECORD

Including the official reports of the British Society of Periodontology, the British Society for the Study of Orthodontics, the European Orthodontic Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odontochirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

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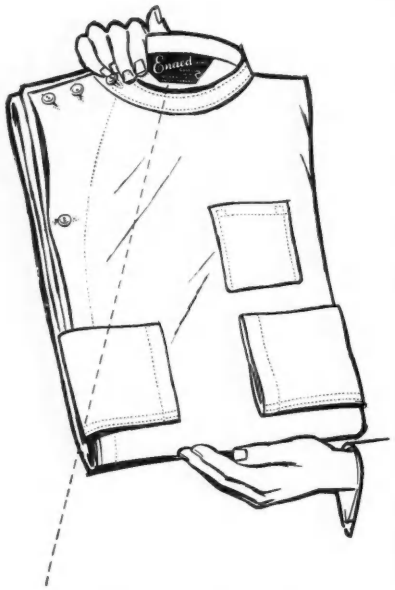

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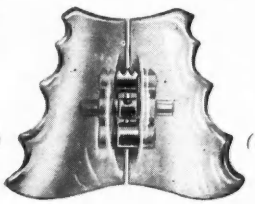

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THE DENTAL PRACTITIONER
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Vol. VII, No. 1 September, 1956

EDITORIAL

XII INTERNATIONAL DENTAL CONGRESS
OF THE INTERNATIONAL DENTAL FEDERATION
(Rome, September 7 to 14, 1957)

THE holiday season for the majority of people has ended and we are now back to the grindstone and daily routine with another winter to face. Despite the accumulated pile of work and the hundred and one things to unravel which always seem to crop up after a holiday, there is perhaps a little time left to plan ahead. Next year may seem a long way off, but it will soon be here and out will come the touring maps of the country-side and the *routes nationale* of the Continent. So we make no apology at this time of year for earnestly bringing to your notice the XII International Dental Congress to be held in Rome from Sept. 7 to 14, 1957. Those who attended the last International Dental Congress held in London at the Royal Festival Hall in 1952 will still have vivid recollections of its outstanding success. These meetings of international importance are held every five years, and members of the dental profession throughout every country in the world assemble together to exchange views and learn of the recent advances in dental science. It is, in fact, a unique opportunity to study at first hand the role of dentistry in world health. Reports are presented on every aspect of dental surgery and dental medicine, as well as demonstrations in each field of dentistry and films and television programmes. In addition there is also to be a special exhibition on Dental Health, as well as an exhibition of Industrial Dentistry. A Book Exhibition will be an interesting new feature. All in all, it will represent a galaxy of dental stars gathered together not only to broaden the mind on the problems of dentistry, but to sit beneath the Italian skies and contemplate on the glories of Rome. We are quite certain that the dental profession of this country will be well represented in Rome next year and that the Congress will be as successful as the London Congress of 1952. Its final success will depend upon your support, which we are sure will be forthcoming.

A WORD OF WARNING

Those proposing to attend the Congress are asked not to wait until the last moment for their hotel reservation.

Rome, being a universal centre of culture, constitutes a permanent attraction, and hotels are fully booked up throughout the whole year. Deadline for hotel reservation is April 30, 1957.

MASTICATORY EFFICIENCY AND PERIODONTAL DISEASE*

By J. W. GALLOWAY, T.D., L.R.C.P. & S., L.D.S.
Lecturer, Periodontal Diseases, Edinburgh University

THE health of any part of the human body depends on its adequate nutrition and the performance of its proper physiological function. The causes of periodontal disease are not known, but when the breakdown of the periodontium occurs it is associated with certain predisposing or aggravating factors. Of these, there are two main groups: Those associated with the nutrition of the tissues, i.e., the systemic or general factors; and those associated with local conditions in the mouth and related to the physiological functions. The local effects attributed to dysfunctional factors are the most difficult to trace and locate and may be the most difficult to combat.

In considering cases of incipient or established periodontal disease, it would be advantageous to be able to assess the structure and function of the patient's masticatory apparatus especially if there is a damaged or defective dentition.

To devise means for the prevention of further destruction and to aid and strengthen the remaining teeth requires an appraisement not only of the extent of the depreciation and the magnitude of the damage, but also the compensation which has been made by altered tooth position or mandibular movements.

An examination and valuation of the patient's masticatory efficiency would be an ideal method of obtaining information. Moreover the ultimate aim of any dental treatment should be to preserve or provide for the patient as high a standard of dental competency as conditions will allow. Therefore, the dentist should have some guide to, or measure of, his patient's dental efficiency.

As in other fields of dentistry, there is a plethora of terms. Terms such as masticatory powers, efficiency, function, capacity, effect, and performance are used loosely and often indiscriminately.

What is masticatory efficiency? It is the sum of the individual's masticatory capacity or "*potential*"; the masticatory ability, skill, or "*proficiency*"; and the result or "*performance*".

That is to say, if the individual has sound teeth (in good occlusion, with intact periodontium, in well-formed arches), well-developed jaws and muscles, and healthy salivary glands, that individual should be able to masticate food efficiently. He has the tools for the job. He has a good masticatory "potential".

Whether the individual is able to use this masticatory potential or not, depends on his masticatory "proficiency", i.e., the proper functioning of his muscles and temporomandibular joints, his neuromuscular mechanism, and the quantity and consistency of his saliva.

If the chewing results in adequately masticated food thoroughly mixed with saliva, the masticatory "performance" is good. Such a hypothetical patient could be said to have a masticatory efficiency of 100 per cent.

Estimation of masticatory efficiency presents many difficulties. It is possible, however, to make a rough clinical judgement of the "potential", which, though not entirely satisfactory, is better than having nothing on which to base a plan for rehabilitation.

The process of eating is something which we are not taught and do not have to learn. The mechanism is provided and instinct is responsible for making it work. The action is partly voluntary and partly reflex.

Generally, physiologists have paid little attention to the first process in the digestion and assimilation of food. To the physiologist the mouth is an opening to the digestive tract in which the food is "ground" by the teeth and is mixed with saliva containing a digestive ferment. Yet this apparently simple process requires a highly complicated arrangement of

* A paper delivered to the British Society of Periodontology in Edinburgh on March 3, 1956.

structures and organs. Nor is this apparatus designed only for the reception and preparation of food. It is necessary also for speech and it is the source of physical and emotional sensations of pleasure.

Orthodontists and prosthetists have made many studies of masticatory efficiency during the last thirty years. Some have estimated efficiency according to the number of functioning teeth; some have studied occlusion and food platform area; some have measured biting strength; some have examined the purpose and function of the inclined planes and interdigitation of the teeth; some have traced the movements of the mandible and the temporomandibular joint; some have observed the process of mastication and deglutition. Each investigator has drawn threads of truth from the whole fabric. Deductions and conclusions have been made from the study of one or more, but not all, factors. Each and all have contributed essential and valuable information about mastication, but, because of the necessary limitations of their experiments, the picture presented, although accurate in one or other detail, has not been complete and comprehensive.

How an internal combustion engine works cannot be explained or understood by the separate study of the purpose and action of the cylinders and pistons, the carburettor, the gear-box, or the transmission. The purpose of each may be clearly defined, and the actions and the reasons for failure may be understood. That is not enough. The importance of one part is closely related to all the other parts. So it is with mastication, and the efficiency depends on the separate parts, how they work, and the successful result of their co-ordinated efforts. The working parts of the masticatory mechanism—the masticatory potential—consist of the teeth, periodontium, jaws, muscles, tongue, salivary glands, and, of course, the vessels and nerves. The masticatory proficiency is the integrated action of the following: chewing movements, habit patterns, biting strength, salivation, swallowing threshold, ability to adapt the action for different kinds of food, and ability to compensate for defects in the mechanism itself.

POTENTIAL

A first approach to the problem is the natural one of an investigation of the teeth. Undoubtedly, an ideal to be aimed at is a complete and sound dentition in good occlusion.

It might be thought safe to say that any defect in the dentition would cause a decrease in masticatory efficiency proportionate to the number of teeth lost, the defects in their attachment, or their displacement from ideal occlusion. But this is not borne out in practice. Loss of some teeth, increased tooth mobility, or malocclusion cause, at most, only a temporary disability. Adaptation to different conditions takes place. The disability is usually severe before a patient admits to an inability to deal with his food to his satisfaction.

This adaptation or compensation takes place as a result of, perhaps, new chewing or habit patterns, or the adjustment of the tongue and muscles of cheeks and lips to new circumstances, or perhaps by a change in diet.

A moderately defective dentition, or deviations from a reasonable occlusion, does not always render the patient incapable of enjoying his usual food. Though digestion may be handicapped, seldom are there evidences of a poor assimilation of food. In fact, Dahlberg (1942) and, later, Manly and Shiere (1950) found that some people with poor dentitions could chew as effectively as those with a good dentition, without having to prolong the chewing period.

However good the adaptation, there will usually be a decrease in masticatory efficiency. It is essential to take note, as a first step in examination, of the number and class of the functioning teeth.

Probably some of the earliest estimations of masticatory efficiency were made by giving a valuation for tooth units, i.e., groups of teeth in functional occlusion. A first attempt (Dahlberg, 1942) was the valuation of one pair of molars as a "unit" and each pair of remaining teeth as half units; making a total of eleven units for a full functional dentition. Other, but similar, calculations have been made (Dahlberg, 1942). The imperfections of this method are obvious. No account is taken

of the position, distribution, or arrangements of the tooth units, or of any other factors. Nevertheless, provided there is a conception of a dynamic masticatory apparatus and provided other parts of the apparatus are not ignored, values given to teeth, proportional to their place and importance, give some indication of the masticatory potential.

The total value so obtained helps to form a general picture of the dental condition and may form a base line for comparison and further investigation. Possible values might be 1 for incisors, 2 for canines, 4 for premolars, 5 for first and second molars, and 3 for third molars, making a total of 100 for the whole dentition. These full values are given only to sound teeth in good occlusion. Tenderness, pain, or loss of substance, stability, or opposition is bound seriously to reduce tooth value for mastication. Therefore a fractional value or no value at all, is accorded to obviously defective teeth.

These values bear a modified relation not only to the functional occlusion, but also to their size, food platform area, position, importance, and health. Such numerical estimations must be adjusted should there be any ascertainable abnormality of bones, joints, muscles.

Dahlberg (1942), for the purpose of his experiments, had first to classify dentitions into good, average, and poor. His method of estimation is a modification of the anatomical points system, and was based not on the number of teeth but on the number of contacts. He calculated that a complete dentition has 32 contacts (26 to the molars and premolars and 6 to the incisors and canines).

Manly (1951) found that masticatory performance was closely related to food platform area and the mesiodistal imprint length of the teeth, and was confident that a prediction of the masticatory efficiency could be made from these measurements—measurements which require time and special apparatus. Such a prediction, however, would not be a much better estimate than tooth unit values, for Manly himself realized that other factors influenced masticatory performance.

Gnathodynamic studies (Worner, 1944) show that the greatest pressure can be exerted in the first molar area and can be accounted for by the size of the crowns and roots and the situation in the region at which maximum muscular force can be exerted. Biting strength is more a test for the muscles and jaws than for the teeth.

There is a general consensus of opinion that the first molar area is the most effective for chewing, but it is not easy to state what is the effect on mastication of the loss of these teeth.

The term "occlusion" is used when the teeth are examined in a state of static relationship, but the term can be used, and some say reserved, for a dynamic relationship. Despite the emphasis which has been laid in recent years on this conception of occlusion as a dynamic relationship, it is nevertheless still not a fundamental principle observed in the examination of the patient. The difficulty is not the conception but the application of the conception. In part, dental education may be blamed. The first introduction to the study of the teeth and jaws is in the anatomy department. An articulated skeleton may have a moveable mandible, but the picture which is created in the mind of the student is one of teeth, fixed in hard bone, which articulate when the mandible is opposed to the maxilla. There is no picture of bone as a living, changing, tissue, of teeth slung in their sockets, or of a mandible that has other than hinge movements. In part, it is the impossibility of examining the teeth clinically in this dynamic occlusion as the movement of the jaws and teeth cannot be watched during the action of mastication.

A different term from "occlusion" is really required for this dynamic relationship which depends both on the shape, size, position, and interdigitation of the teeth, and the means by which they are brought together. It is not a matter of teeth only, but the whole masticatory apparatus.

What is generally termed a "balanced" occlusion is not really a dynamic occlusion, for what is tested and examined is not the relationship during movement and function but the adequacy of contact of the teeth in certain positions of the jaws. In fact does bite

analysis on the articulator give accurate information of mandibular movements or merely the nearest possible simulation of them? Can we be sure that the observed "balanced" occlusion *is* balanced during the individual's normal movements of his mandible, or are we assuming that it is?

In fact, we know that the periodontium can be healthy and the masticatory proficiency satisfactory though the teeth show an apparent absence of "balanced" occlusion. That this is so may be due to normal or compensatory movements of the mandible of which little is known and which can be recognized only when there are gross changes in the movements or positions of the mandibular joints.

Whereas radiographic, visual, and aural examination, palpation, and the study of models on special articulators can give information about bony structures and joints, the examination of muscular action demands material and apparatus which, as yet, is beyond the scope of routine procedure.

If the important structure is the mandibular joint, as some maintain, its development and its complex movements depend as much or more on the musculature than on the relationship of the teeth. There is a body of opinion to support the belief that the joint no less than the alveolar bone changes with advancing years or as an adaptation for different conditions. There is no definite agreement about the respective importance of muscles and bone. Probably it is impossible to say. Sicher (1954) says that the normal combination of the rotatory with the sliding movement of the mandible is deeply fixed in the neuromuscular pattern of the mandibular muscles. Gratzinger (1951) has related certain periodontal pathology to the effect of muscular forces and states that traumatic lateral forces on the teeth can be produced either by the muscles of mastication or by lack of retentive balance of the tongue, lips, and cheeks.

Certainly, periodontists have been concerned mainly with the effects of traumatic occlusion on the periodontal membrane and the alveolar bone and too little attention has been paid by them to the effect on the teeth of disharmony of the muscular forces and the resultant effect on the structure of the alveolar bone and the mandibular joint.

The questions of the constancy or inconstancy of the mandibular joint, the constancy or inconstancy of muscular action and mandibular movements after tooth loss demand, in the present state of knowledge, an open mind, but they are factors which cannot be ignored in an examination of masticatory efficiency.

A muscular organ even more difficult to examine than the muscles of mastication and expression is the tongue.

Abnormal actions of the tongue in eating and speaking, or disharmony between the tongue and the cheek and lip muscles are contributory factors in the pathological wandering of the teeth and these factors are more important than occlusal factors. Orthodontists are well aware of the action of the tongue influencing the position of erupting teeth. Similar actions will influence teeth with weakened periodontal attachment. Moreover, as teeth are lost the tongue becomes more important in masticatory action and in the edentulous mouth may be able to deal with a wide variety of foods.

Obviously, dogmatic opinions must not be regarded as proved facts and further study must be made. The periodontist's position should be that "if a man will begin with certainties he shall end in doubts, but if he will be content to begin with doubts he shall end in certainties" (Bacon).

PROFICIENCY

Descriptions of the act of mastication are apt to be over-simplified, and as a result there are erroneous assumptions and conceptions. Especially is this so with regard to the functions of the teeth. Generally it is stated that the incisors separate a portion of the food from a mass and the "grinders" grind it into small particles. Now "grinding" implies the friction or the rubbing together of two surfaces. This idea of "grinding" the food must come from watching cows and horses, but certainly not from watching human beings.

Thompson (1954) says, "in these days of technological advance it must not be forgotten that the most important diagnostic record is

still the patient". The human "grinders" do not grind, for, if they did, it would be agony to watch the guests at our table. The human "grinders" tear and crush; the food is broken, sheared, bruised, and squeezed between the teeth. The term "comminution" is better than "grinding" for such actions. The food is not reduced in size by the friction of teeth rubbing together like upper and nether millstones.

If the food is easily sheared or cut (e.g., the dainty sandwiches of an afternoon tea-party), the incisors may act alone and a portion of the food is separated from the larger mass before the teeth come into contact. If the food is resistant or tough, the incisors are used in a prehensile manner and the food is divided by a pulling action of hand and head. Assisted by the hands, the incisors may be used in a nibbling manner which is also mainly a prehensile mode of action.

These latter actions may not be evident in refined society where knives and forks perform the work which should be undertaken by the incisors and canines. Jankelson, Hoffman, and Hendron (1953), in their cinefluoroscopic studies, noticed an oscillatory movement of the incisors when particularly hard food was bitten. This was judged to be a method of control to prevent sudden heavy contact of the teeth.

The portion of food once it has been transferred to the mouth is subjected to a highly co-ordinated action of jaws, tongue, and teeth to prepare it for swallowing. How much preparation is done depends on the individual's "potential", the degree of hunger, the time allotted for the meal, the refinement of the eater, the character of the food, its hardness, toughness, moistness, taste, and flavour. The hungry, angry, hurried, or worried man bolts his food irrespective of whether it has been masticated or not. The softer, smoother, and the more pleasant the food the less time it spends in the mouth. Prolonged chewing destroys the pleasure of taste and flavour. Food which is hard and dry requires to be broken and lubricated with saliva so that the quality of the bolus is appropriate for the swallowing threshold.

Chewing is negligible for soft foods, but if the food must be prepared for swallowing it is crushed and torn by the shearing action of the teeth and their controlled pressure.

As the mandible opens from the rest position to a lateral position, the food is placed and held in position by the tongue assisted by the barrier action of the cheeks. As the mandible returns, and as the teeth come into their habitual centric position, the food is sheared and crushed. As the teeth approach complete closure, the jaw immediately opens and the food is again gathered and replaced in position for the next return movement of the mandible. This masticatory cycle is repeated, and (as the food is gathered and replaced for further comminution) the juices of the food and the saliva are incorporated in the bolus. Usually, separation of sufficiently masticated food from the bolus is undertaken, during the gathering and replacement in position, by the tongue. The bolus is often swallowed piecemeal, and the food requiring further chewing is retained or sometimes rejected.

It is probable that the general pattern of movements is constant for each individual, though there will be modifications depending on the character of the different foods eaten, and when there are pathological or other abnormal conditions of the masticatory apparatus. But there will be many varieties of the masticatory cycle, especially when there is malocclusion or maldevelopment of muscles, bones, or joints. Sir Thomas Browne said: "It is a common wonder of all men, how among so many millions of faces there should be none alike." It is highly probable, also, that among so many millions of masticatory cycles there may be none alike. But in the vast majority of masticatory or chewing movements when there is no gross abnormality, certain general conclusions ought to be emphasized: (1) During mastication, the teeth on the working side are separated by the food undergoing comminution. (2) The food is still between the teeth as they move towards centric occlusion. (3) As soon as the teeth approach complete closure there is a rapid opening of the jaw. (4) This reflex opening of the jaws can be prevented by voluntary control,

particularly when hard or tough food is being eaten. Then extra pressure must be consciously controlled lest the teeth are suddenly jarred by a sudden collapse of the bolus or lest the pressure approaches or reaches the pain threshold of the periodontium. (5) As the teeth on the working side are separated by the thickness of the food between them, there is no contact at all of teeth on the balancing side. (6) In ordinary mastication the teeth do not contact in lateral or protrusive positions of the mandible. (7) Apart from the necessary muscular action to produce the modified pressure exerted in squeezing the food, biting strength, as measured by the gnathodynamometer, is not a force utilized in mastication. Biting strength is necessary for holding or tearing food, and in modern days is exerted for opening bottles or cracking nuts—that is when the teeth are being used as an implement or tool and not for chewing. (8) In this day and age, mastication occupies less than one hour in twenty-four.

If these are general statements of fact, it means that any great degree of trauma does not occur during mastication unless there already exists a pathological condition of the periodontium, more especially if that condition has rendered the teeth mobile. But, the teeth are firmly in occlusion during the act of swallowing and when there is any form of bruxism. The term "bruxism" is here used to include all oral habits which involve clenching or grinding of the teeth.

In swallowing, the teeth are in habitual centric occlusion and forcibly opposed to an extent which has been described as "clenched" (Syrop, 1953). In the adult, swallowing with unoccluded teeth is an abnormality. Swallowing occurs during the whole twenty-four hours at the rate of once every sixty to seventy seconds. As far as is known, no one has measured or taken note of the resultant force of the occluding teeth during swallowing. It is by no means negligible. It is not unreasonable to suppose that if trauma is caused by an "unbalanced" occlusion, it takes place during swallowing rather than during mastication of civilized or modern diets, and, if so, then the relationship most important is during the movement into and the habitual centric occlusion. Lateral and protrusive closed positions of the mandible are positions related more to bruxism and other oral habits than to either mastication or deglutition. These abnormal positions play an important part in the production of traumatic pathological changes in tooth structure and periodontium, but only in so far as they may affect adversely the masticatory apparatus, they are not related to masticatory efficiency.

Mastication is not possible without saliva. Saliva is probably more important than the teeth. In mastication it has two main functions: that of lubricating and that of dissolving. The action as a solvent helps in both the reduction of the size of the bolus and the appreciation of tastes and flavours. The stimulation of taste stimulates the flow of saliva no less than do the movements of the tongue and the friction of food against the oral mucosa. There is great difficulty in swallowing dry food and it would seem that the moistness of the bolus is as important a factor as particle size. It is known that the saliva under different circumstances in the same individual varies in composition and hydrogen-ion concentration with the nature and intensity of the stimulus. The amount, composition, and hydrogen-ion concentration of the saliva depends on the nature of the substances taken into the mouth. Pleasant food excites a moderate flow of viscid saliva, whereas dry foods excite a flow of thin watery saliva. Psychological and emotional states also affect the flow of saliva. The variable rate of flow and of composition may have an important bearing on chronic gingivitis. In cases of xerostomia the oral mucous membrane is smooth, dry, shiny, and is easily injured, and in addition there is difficulty in eating and swallowing. The absence of moisture and lubrication is also seen in mouth-breathing or the open lip posture, where the gingiva is chronically inflamed and shows a tendency to hyperplasia of the interdental papillæ.

A common aid or addition to this salivary function is the simultaneous imbibing of fluids while food is being chewed. Drinking and eating at the same time not only softens and

macerates the food, but also allows larger particles of food to be swallowed or washed over.

Butter and jam with bread, milk with puddings, gravy with meats, and custard with tarts, all contribute to a well-lubricated bolus and easily macerated food.

The "swallowing threshold" is an abstract conception. The decision to swallow seems to be a joint decision of the senses of the tongue, fauces, uvula, and throat. The size of the particles in the bolus, the moistness and smoothness of the bolus, and the sensations of pleasure or distaste are factors which enter into this decision.

PERFORMANCE

It is not sufficient to understand the machine and how it works. It is necessary, also, to consider the work to be done. To know what is to be eaten and how much chewing will be required is essential, for the mouth, as we have seen, has different ways of dealing with different foods.

How does the man in the street rate his efficiency? He is content with a standard of efficiency which enables him to enjoy his daily menus, especially what he fancies.

What of the physiologist? He is concerned with the complex and complicated procedures of digestion absorption, assimilation, and elimination. Mastication is a necessary preliminary procedure so that saliva may be incorporated with the food. The teeth are there for chewing and if the food is not chewed, digestion may be slowed down.

What of the dietician? He is satisfied with individual food requirements, with calories and vitamins and mineral salts. He is satisfied if the food which is swallowed will produce good teeth, and, so far, has failed to realize that the masticatory apparatus must have adequate function as well as nutrition.

What of the cook? He aims at serving appetizing food with aromas and flavours in variety, cunningly combined to prevent satiety. The dishes he presents are tender or succulent or luscious, and pander to the glutton in man. Otherwise he would lose his job.

What of the food purveyor or manufacturer? "Why bother to cook?", he says. "Allow me to present my delectable, delicious, packed food; grown, gathered, devitalized, revitalized in ideal surroundings; ready to serve, no cooking required, merely add hot water; guaranteed to placate the man and please the child." He doesn't mention that it has to be eaten. He probably doesn't care as long as it is sold. But precious little chewing will be necessary.

What of the dentist? Nutrition was not a subject in his final examination, but he has picked up some useful knowledge. He knows about calcium, and the vitamins, and fresh fruits and vegetables, and how good for the teeth are coarse and fibrous foods. He advises his patient to change his diet and knows that the patient won't.

What of the dental research worker? "Here are three grams of peanuts. Chew these twenty times or until you are ready to swallow, then spit it out into here." He discovers, after washing, measuring, and weighing the particles, that the patient's masticatory efficiency is 10 per cent.

A man must eat to live—eat, but not necessarily chew. What a man wants is a full belly. If he can, at the same time, satisfy his appetite with less labour and more pleasure, so much the better. In satisfying the cravings of hunger, man has eaten everything from shoe leather to human flesh, but he prefers to consume food which can be eaten easily and with pleasure. Hence we have knives and forks, and cooking.

How long is it since the ordinary man's existence depended on his ability to chew tough, hard, or fibrous food? The primitive or savage man alternates between plenty and scarcity, and, in such circumstances, food is devoured in gulps without thought of mastication and still less of delicate flavour. Records of food and meals in the social history of this country seem to show that, rich or poor, the eating of food required very little hard work for the teeth. The food, perhaps, was coarser. There was more dirt and more grit and there was less variety. The diet of the peasant varied very little until the latter part of the last century. It consisted mainly of bread or oatcakes, dairy produce, and bacon or herring.

Vegetables are comparative late-comers. Brose made of peasemeal or oatmeal was a common dish even amougst town dwellers. Bread was a staple article of diet as it was the cheapest means of satisfying hunger as well as providing the calories. The teeth of old skulls show considerable wear of the teeth by attrition. Such teeth must have had sound attachments. It is difficult to account for their extreme and even wear if the character of the food is considered to be the cause unless it was due to the use of stone-ground flour.

Civilization, increasing population, and the congregation of that population in towns, have gradually made necessary a colossal organization for the supply, transport, and storage of food. The diet of the British people has gradually and imperceptibly changed with this development. The science of nutrition has had its influence and diets have become more varied and better balanced. Yet the necessity for using the teeth has become less and less. A brief examination of the diet of an ordinary family will convince anyone that little or no vigorous chewing is required. The selection of the family foods depends on the likes and dislikes of the housewife and, perhaps, as much on her dental fitness as on the amount of her housekeeping allowance or her capabilities as a cook. Her choice of food depends also on what the trader can supply. She is bound, too, by custom and tradition, by likes and dislikes, by the snobbery of her social class, by her state of mind and body, and a host of other indeterminate factors.

Food must be considered from two points of view; that of adequacy for the maintenance of the anatomical structure and of the physiological functions of the body and that of the necessity for mastication. The teeth and the periodontium have the same nutritional needs as any other tissue of the body. They have the same need for functional use. But how much functional use in the form of hard chewing is necessary for the health of the dental tissue? The fact that man through the ages has always preferred food which is easily consumed has some significance. It may be because he is inherently lazy. He may be wrong in seeking the easily munched delights of the table. Yet, apparently, there have been many who have maintained a sound dentition with a diet which could be managed with reasonably good artificial dentures. Undoubtedly heredity, race, climate, and the constituents of the food may all be reasons for these healthy teeth. As far as food is concerned, the difference might seem to be not so much in the hardness and toughness or the amount of chewing required as in the content of hard abrasive particles. The attrition which can be seen in the present population of this country is not due to wear by chewing food, but is produced either by bruxism or perhaps by normal mandibular movements on teeth with a particular enamel structure.

For a number of reasons, there is too great an endeavour to refine foods. If wheat is taken as only one example, it is found that its preparation into flour is a long process. It is no longer stone-ground. It goes through a process of cleaning, scouring, brushing, washing, milling with steel rollers, purifying, bleaching, and powdering. There is neither grit from the fields nor grit from the millstones, and in the baked loaf there are chemicals to keep it soft and moist.

The more one studies diets, the more one realizes that the sources of the periodontal effects of traumatic occlusion must be sought for in the action of deglutition and in the habits of bruxism rather than in the action of teeth during mastication.

This survey of what constitutes masticatory efficiency shows that there is still much to learn before a reasonably accurate valuation can be given. What is possible at present is an estimate of a patient's "potential". This estimate can be made by a thorough clinical and radiographic examination, by an investigation of patient's health, diet, and habits, and by a study—a partial study—of the occlusion by means of bite analysis.

The examination and estimation of a patient's proficiency still lies in the academic sphere. Practical tests with particular items of food is a strict trial, but does not give the whole answer. Examination by myelography, oscillography, palatography, laminography,

cinefluoroscopy, and cinematography are certainly not everyday procedures, but they are methods by which a fuller and more exact knowledge of the physiology of mastication may be obtained. If the physiology is known the pathology will be understood. The development of jaws and teeth and the effect of growth and masticatory forces on bone up to the age of maturity have been thoroughly studied by orthodontists. The effects on these structures and forces of tooth instability or loss in adult years are less well understood. The periodontist must have a similar outlook to the orthodontist and, indeed it would be advantageous if they were close partners.

The investigation of the predisposing and aetiological factors of periodontal disease must always take into account this question of masticatory efficiency. It is not sufficient to base a diagnosis or a prognosis on an examination of the occlusion of the teeth. Such an examination does not lead to the discovery of the dysfunctional forces that are harming the periodontium. These damaging forces are more likely to be discovered if there is a full appreciation of this conception of masticatory efficiency as a sum of three components and that the masticatory apparatus is a constantly changing mechanism.

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DISCUSSION

Mr. F. E. Hopper congratulated Dr. Galloway on his interesting paper. He considered that the term "masticatory efficiency" and others such as "masticatory potential" and "performance" have been given, in the past, a pseudo-scientific accuracy by research workers concerned with the ability of the individual to comminute salted peanuts. It is felt that the basic underlying assumption that teeth are necessary needs questioning. Does the efficiency of the dentition in breaking food into an easily swallowed mass have any relationship to the utilization of that food in the gut?

This approach is one that has been largely neglected and I am glad to be able to bring to your notice the recent work of a colleague of mine from Newcastle who has carried out an extensive programme of research designed to show the difference in absorption between chewed and unchewed food. Mr. John Farrell selected for his investigation a wide range of food including bread, rice, potatoes, and various forms of boiled, roasted, and fried meat. In this experiment many foodstuffs, including boiled and fried potatoes and most cooked meats, showed a greater increase in the amount digested when chewing was carried out when compared with the unchewed specimen. This held good, even when the few remaining teeth in the mouth indicated a very much reduced chewing efficiency. Other foodstuffs studied were equally well digested, chewed or unchewed. This work leads us to believe that the mere mechanical ability of the teeth to triturate food is not necessarily a reasonable basis on which to assess the value of a given dentition.

The relationship between "masticatory efficiency" and periodontal disease may be largely concerned with the possible damage produced by chewing movements made when there is no food in the mouth. The relationship between the teeth and digestion may be a very tenuous one and our efforts towards the preservation of teeth may be more easily justified on other grounds.

Fifth Column within Normal Dental Occlusions

Using fine-pointed dividers 500 sets of models were measured to determine the mesiodistal diameters of each permanent tooth. Ninety per cent of cases showed left–right discrepancy in one or more pairs of teeth.

Measurements on 500 orthodontic patients show that in more than 50 per cent the total mesiodistal width of the lower six incisors is 2 mm. or more in excess of their ideal relationship with the total mesiodistal width of the upper six anterior teeth.

In the manufacture of artificial teeth "the combined mesiodistal widths of the lower six anterior teeth is 75 per cent of the combined widths of the upper six anterior teeth. This relationship gives an average overjut of 1·0 mm."

This mathematical formula was satisfactorily tested on 20 completed orthodontic cases which were considered to have been ideally treated with very favourable results.—BALLARD, M. L. (1956), *Amer. J. Orthodont.*, **42**, 116.

EOSINOPHILIC GRANULOMA

By **E. S. BROADWAY**, B.D.S., F.D.S., D.Orth. R.C.S.
Senior Registrar to St. Thomas's and Royal Dental Hospitals

CASE reports of eosinophilic granuloma affecting the jaws are very uncommon in the dental literature of this country. Recent cases have been reported by Hankey (1938); Nesbitt (1955), who reported a case in a child resulting in the loss of deciduous teeth and destruction of the alveolar process; Lucas and Greer-Walker (1950), who reported a single lesion at the angle of the mandible, the follow-up in this case being for two years prior to publication.

The lesion may be single or multiple, involving no particular bone (Engelbreth-Holm, Teilum, and Christensen, 1944). The aetiology of the disease is not known, some attributing it to trauma, others to a virus infection causing an inflammatory lesion in bone. Controversy still exists as to the exact nature of the condition; the most generally accepted view is that of Farber (1941), who describes it as a variant of a basic disease of which Hand-Schüller-Christian and Letter-Swies disease are other examples. It would appear from the literature that while Hand-Schüller-Christian disease is most common in the first decade of life, eosinophilic granuloma occurs more commonly in the second and third decades. Males are more commonly affected, symptoms are slight, and blood and urinary investigations reveal no significant changes; single lesions are more common than multiple. Radiographically the disease has no specific appearance; it may simulate a dental cyst or chronic osteomyelitis.

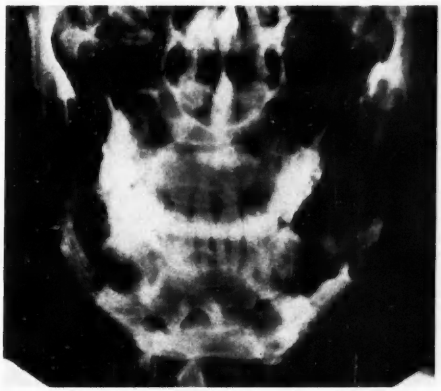


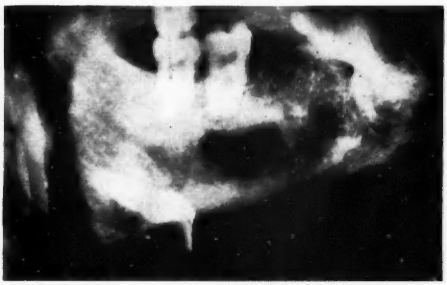
Fig. 1.—Postero-anterior view of mandible, showing original condition. There are multiple well-defined radiolucent areas throughout the bone.

Fig. 2.—Lateral view of right mandible, showing radiolucent areas in the bone unconnected with the teeth.

Fig. 3.—Lateral view of left mandible, showing multiple cyst-like condition. One area appears to be associated with the first molar, which has a large distal cavity.

In 1929, Finzi reported a child of 15 with a lesion in the frontal bone, and since then

various authors have reported cases under different titles. Jaffe and Lichtenstein (1940) proposed a nomenclature, and Holst, Husted, and Pindborg (1953) reviewed the literature in detail. The latter found 24 cases with lesions in the mandible, of which 13 had involvement of other bones.



Figs. 4, 5.—Lateral views of the mandible to compare with *Figs.* 2, 3. These views were taken 18 months post-operatively, and show considerable bone regeneration.

CASE REPORT

HISTORY.—R. J., a male, aged 24, complained of aching teeth in the right side of the mandible whilst serving in the R.A.F. in 1952. Four or five teeth had been extracted from the right mandible at various times during his service with the R.A.F. Since the removal of these teeth he had complained of intermittent swelling and pain over the right side of the mandible. Referred to the Dental Department of St. Thomas's Hospital in January, 1954, complaining of pain and swelling over the right mandible.

ON EXAMINATION.—There was fluctuant swelling over the right mandible, with palpable submandibular and upper cervical glands. Slight trismus was present; intra-oral examination showed a small sinus in the second molar region from which pus was draining. Radiographs of the right mandible showed several areas of bone destruction, some of which extended through the alveolar margin, and there was marked destruction of bone at the angle of the jaw. The appearance suggested an osteomyelitis, possibly superimposed on a multilocular cystic condition (*Figs.* 1–3).

The patient was admitted, and under a general anæsthetic the area was explored, a small amount of pus was evacuated, several cavities containing a solid fibrous tumour were curetted, and material sent for histological report. Healing was uneventful.

The pathologist's report was that the tumour consisted of chronic granulation tissue in and around bone containing a moderate but not excessive number of eosinophils. Culture of the pus grew *Str. viridans* and *N. catarrhalis*; no pathogens were grown (*Fig.* 6).

In view of these reports it was decided to carry out a radiographic survey of the skeleton, and a thorough blood examination to exclude general disease. The radiologists reported:—

Chest: No deposits seen. No lesions noted in heart or lungs.

Skull: No deposits noted.

Pelvis: No deposits noted.

Hands: No deposits noted.

Mandible: Extensive areas of bone destruction and evidence of operative interference in the right mandible; less extensive lesions are present on the left side (*Figs.* 1–3).

Blood examination: The hæmoglobin, differential white-cell count, absolute eosinophil count, sedimentation rate, plasma alkaline phosphatase level, and plasma calcium, were all within normal limits.

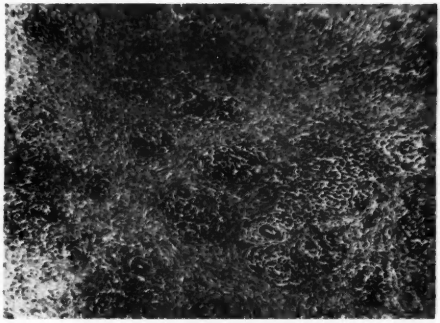


Fig. 6.—Low-power photomicrograph of the tumour, showing focal groups of eosinophils in chronic granulation tissue.

A tentative diagnosis of eosinophilic granuloma was made, the disease being confined to the mandible.

A second operation was decided upon to remove all the remaining tumour, and to confirm the diagnosis. The patient was readmitted, and under general anæsthesia the tumour was excised with difficulty through an extra-oral approach and the bony cavities were thoroughly curetted.

The pathologist's report on the tumour was that it consisted of chronic granulation tissue, containing foam cells and groups or focal collections of eosinophils. This confirmed the diagnosis of eosinophilic granuloma.

Healing was uneventful, and there has been no recurrence of symptoms to date. *Figs.* 4, 5 show

radiographic condition 18 months post-operatively. Follow-up over the last two years has shown progressive regeneration of bone, and on March 13, 1956, radiographs of the mandible showed only two small areas of radiolucency.

Acknowledgements.—I would like to thank Mr. J. H. Hovell for permission to publish this case; Professor R. B. Lucas for the pathology reports and photomicrographs; and the medical photographic department of St. Thomas's Hospital for prints of the radiographs.

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CASE OF BILATERAL GEMINATION OF DECIDUOUS INCISORS WITH CONGENITAL ABSENCE OF PERMANENT SUCCESSORS

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THE relationship of the congenital absence of specific teeth in certain individuals to the general process of the natural reduction in the human dentition, is of great interest and must be closely allied to the mystery of inheritance and the genes. At what point does the physical phenomena of size of parts in the embryo so place them that abnormal fusion of units occurs! And at what stage does the physical force become not an environmental one but an alteration of the genes or their patterns so as to assure the inheritance of the same occurrence without the specific feature of crowding! It is feasible to reason that at some, possibly abrupt, stage an alteration of the gene pattern occurs so that an inheritable factor arises. These, perhaps vague conjectures arise from the following histories.

The parent of an orthodontic patient (male) requested the writer to inspect her younger child (female) as she feared there may be a developing malocclusion. She was particularly anxious as the older child's treatment arose partly as the result of a unilateral congenital absence of a lower incisor, the $\overline{2}|$. X-rays had been taken of the older patient before the loss of all the deciduous incisors. The clinical picture at the time was $\frac{6\ DC\ 1|1\ CD\ 6}{6\ DCB1|12CD\ 6}$ present and erupted, and the X-rays showed $\frac{5432|2345}{543\ |\ 345}$ present and unerupted. There was no sign of the $\overline{2}|$ or of any pathological process.

The younger child, aged 8 years 5 months in January, 1956, showed the following clinical picture: $\frac{6\ DC21|12C456}{6E\ CB1|1BC\ E6}$. The BC of each lower segment showed gemination, and the X-rays (*Fig.* 1) appeared to indicate that each $\overline{BC}|\ |\overline{BC}$ had two crowns, a common pulp chamber but two pulp canals (*Fig.* 1 B, C). Resorption of the roots had progressed normally to a considerable extent. According to Professor Stones (1951), fusion occurring twice in the same dentition is rare.

In both cases the permanent successor to the deciduous lateral is absent. The report of the radiologist was to the effect that the $\overline{2}|\overline{2}$ were congenitally absent and that the developing teeth in the region were in all probability $\overline{3}|\overline{3}$. Whether these will be normal or otherwise remains to be seen, but I feel that the X-rayed shapes of the teeth justify the report. During my undergraduate studies I was taught that the canine is the most constant tooth in the dentition and rarely concerned in partial anadontia.

According to Widdowson (1948) calcification of the deciduous incisors commences in the fifth month in utero, the crown being fully calcified by the fourth month of postnatal life.

her knowledge in any of her or her husband's relatives. Both children are healthy and of reasonable build, with well-shaped dental arches.

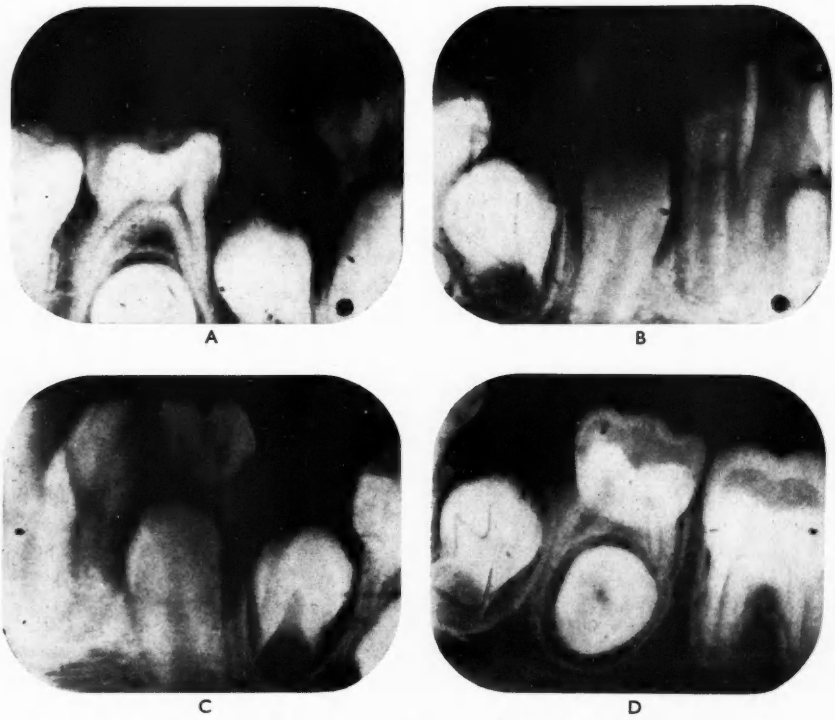

Fig. 1.—Radiographs of a child aged 8 years 5 months. It is indicated that each $\overline{BC}|\ |\overline{BC}$ has two crowns, a common pulp chamber, but, as shown in B, C, two pulp canals.

It would be reasonable to estimate that fusion had occurred at some time just before birth, and as the enamel organ of the permanent successor only arises during the sixth month in utero, suppression by fusion would be a possibility.

The relationship between gemination of the deciduous and suppression of the permanent successor is of interest here, as the older patient showed absence of the $\overline{2}|$ without gemination of the deciduous, whereas his sister shows bilateral gemination of $\overline{CB}|\overline{BC}$ and congenital absence of $\overline{2}|\overline{2}$. The mother could not describe any similar conditions to

Acknowledgements.—Appreciation is due to Dr. Gawne, County Medical Officer of Health, and to Mr. L. B. Corner, Principal School Dental Officer, Lancashire County Council Health Department, for permission to use records and X-rays from the Orthodontic Clinic.

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BACKWARD DISPLACEMENT OF THE PROXIMAL INTERPHALANGEAL JOINTS OF THE THIRD AND FOURTH FINGERS RESULTING FROM FINGER SUCKING*

By **E. S. BROADWAY**, B.D.S., F.D.S., D.Orth. R.C.S.
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CASE REPORT

A GIRL of 13 years attended the Orthodontic Department of the Royal Dental Hospital with a history of persistent finger sucking since infancy. Vigorous finger sucking occurred at night, when excited, and during lessons at school. She fully realized the effect that this habit was having, but found it impossible to give up. *Fig.* 1 shows the finger sucking position.

Fig. 1—Showing finger sucking position.

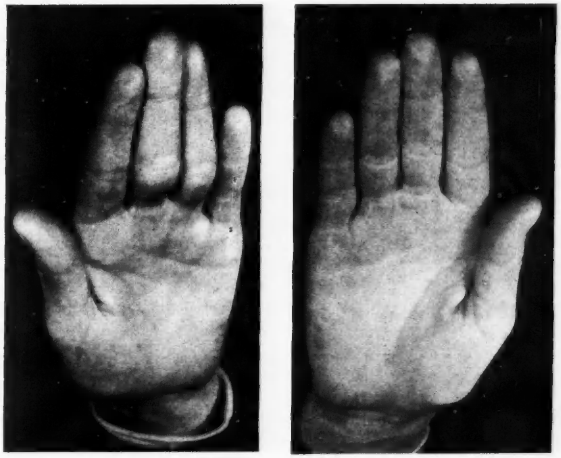

Fig. 2.—Comparisons of left and right hands.

The Hand.—The left hand showed hypermobility of first interphalangeal joints of the third and fourth fingers. Radiographs of the hand showed stretching of the joint capsules and hyperextension of the affected joints. There was protrusion of the distal articular surfaces of the proximal phalanges of the third and fourth fingers on to the ventral surface of the hand (*Figs.* 2, 3).

Physical examination showed no evidence of hypermobility of other joints.

The Orthodontic Condition.—Cephalometric assessment showed a Class 2 skeletal pattern (*Fig.* 4). The upper incisors were at a normal angle to the Frankfort plane. The lower incisors were retroclined on a low FM angle. The occlusion was a mild Angle's Class 2, division 1. There was no anterior open bite. (*Fig.* 5.)

Oral Muscular Behaviour.—Observation showed a normal tooth-together swallow with no evidence of tongue thrust. The lips were habitually together. There was slight contraction of the mentalis muscle to maintain the competency (*Fig.* 6). The upper incisors were under control of the lower lip during swallowing.

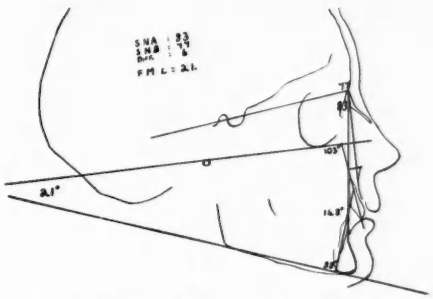

Fig. 4.—Tracing of cephalometric radiograph.

* A short casual communication given at the meeting of the British Society for the Study of Orthodontics, February 13, 1956.

DISCUSSION

Digital deformity caused by finger sucking in infancy is not uncommon, but is usually of a temporary nature, the deformity correcting itself when the habit is given up. In the case presented the deformity is gross, the habit persists, and there is permanent stretching of the joint capsule.

Generalized hypermobility of joints does occur in certain rare general diseases. In cretinism laxity of the joints occurs. Fairbanks reports four cases of laxity of the finger-joints occurring in patients with chondro-osteodystrophy. The same authority reports cases of arachnodactyly or spider fingers, in which disease there is hypermobility of the digital

Fig. 3—Comparison of radiographs of fingers.

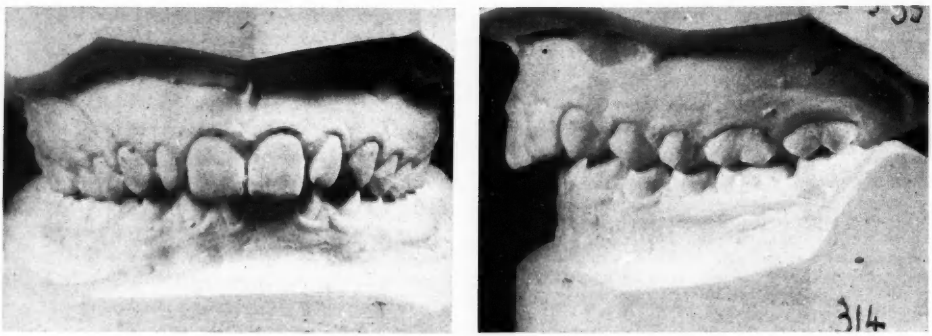

Fig. 5.—Models showing occlusion.

joints associated in 50 per cent of cases with dislocation of the lens in one or both eyes.

The damage to the joints in the case presented is probably permanent. Plastic surgery can offer a satisfactory repair, but only if the competent lips, and the fact that the upper incisors are under control of the lower lip.

Treatment with a monobloc appliance has not been successful. The patient would not tolerate the appliance, the sucking of fingers

Fig. 6.—Lip posture at rest.

habit is given up. Forcible restraint of the finger sucking may result in a more disastrous habit forming. Mr. Walther has shown me a case in which forcible restraint of thumb sucking resulted in nocturnal enuresis.

The minimal effect of finger sucking on the teeth in the present case can be explained by the normal swallowing action, the potentially being preferred. It is hoped that the patient will soon outgrow this unfortunate habit, and then cosmetic surgery to the hand can be considered, and the malocclusion treated.

REFERENCE

FAIRBANKS, H. A. T. (1951), *Diseases of the Skeleton*. Edinburgh: Livingstone.

Nutrition in Oral Surgery and its Relationship to Wound Healing and Infection

The urge of tissue to heal is almost as great as the urge to live. When the available proteins, vitamins, and minerals are depleted below certain levels cellular division cannot occur, nor can intercellular substance be produced, and, therefore, tissue repair cannot take place. A nutritional deficiency is caused by a nutritional inadequacy, which may be either dietary or conditioned. Conditioned deficiencies have been classified into six groups: (1) Interference with ingestion; (2) Factors increasing nutritive requirements; (3) Interference with absorption; (4) Interference with utilization; (5) Increased excretion; (6) Increased destruction.

Wound healing is divided into four species: (1) The quiescent period; (2) Period of granular contraction; (3) Period of epidermization; (4) Cicatricial period.

Water, proteins, carbohydrates, fats, minerals, vitamins, are all necessary in a balanced diet. There is a real difference between optimum and just adequate nutrition and every practical effort should be made to apply this knowledge in the interests of human welfare.—WALKER, D. GORDON (1956), *Oral Surg.*, **7**, 797.

TEMPOROMANDIBULAR JOINT: INTERPRETATION OF RADIOGRAPHS

By **D. C. BERRY**, M.D.S., and **A. O. CHICK**, Ph.D., M.D.S.
Department of Dental Prosthetics, University of Bristol

THE interpretation of radiographs of the temporomandibular joint is becoming increasingly significant. The diagnosis and treatment of occlusal and joint disorders frequently calls for X-ray confirmation of clinical findings. It is therefore of some importance that we should know which bony parts we are seeing when looking at a temporomandibular joint radiograph.

The variation between techniques available for radiography of the joint suggests that as yet no one completely satisfactory method has been developed. The anatomical difficulties are formidable, and in order to minimize overshadowing by intervening structures, all the present techniques will produce some degree of distortion. Perhaps the ideal, if it were possible, would be a radiological approach along the condyle axis, the film being at right angles to this axis. Such a method would at least show the true profile of the condyle (*Fig.* 1). The general outlines of the condyles seen from this approach are obviously rather different from those seen in the average temporomandibular joint radiographs obtained by one of the standard techniques.

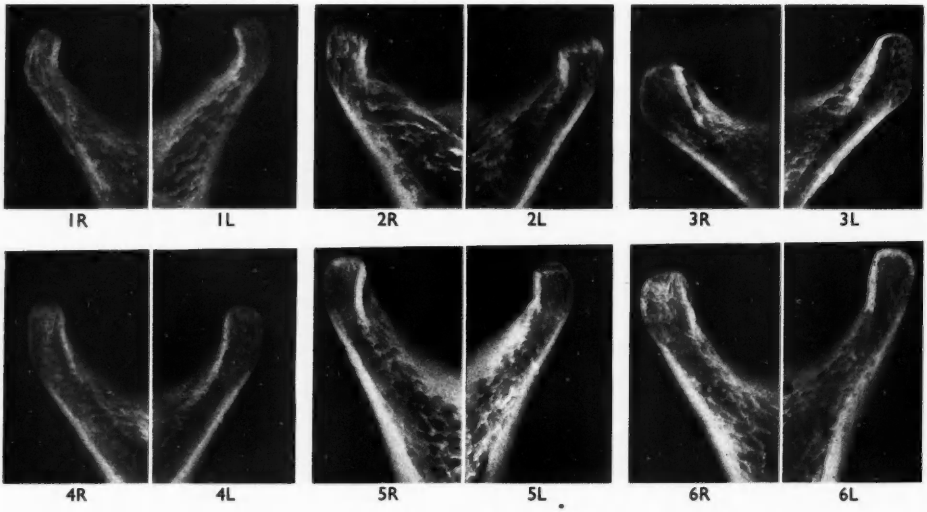

Fig. 1.—Right and left condyles from six skulls, radiographed along condyle axis.

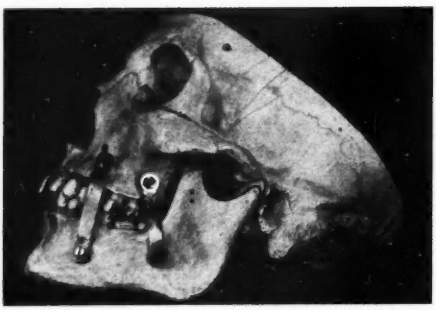

Fig. 2.—Skull fitted with brass locking strips. Acrylic distance piece in left temporomandibular joint.

This problem of distortion cannot at present be overcome; but it can be reduced to the minimum by an acceptable technique. The use of positioning apparatus will permit the tube/patient relationship to remain constant, thereby maintaining the degree of distortion at the same level for any one particular patient. Obviously, techniques employing different tube angulations will differ in the distortion produced.

Fig. 3.—Brass ligature wire adapted to upper articulating surface of right temporomandibular joint; ball-bearing markers in position.

Previous work on the localization of those parts of the temporomandibular joint responsible for the radiological outlines suggests that the radiographic "slice" lies at the junction of the middle and lateral thirds of the articulation (Boman, 1925; Donovan, 1954). However, it is probable that this slice is not in a flat plane. Using a symmetroscope, Ruskin has shown that the radiological condyle outline is produced by bony surfaces that do not lie in a flat plane: and that the same applies to the radiological outline of the fossa and eminence, which is produced by bony structures that do not lie directly above those of the condyle (Ruskin, 1952).

The possible methods of approaching the joint radiographically can be broadly divided into those which employ an entry point for the central ray in front of the ear, and those utilizing a point behind the ear. Profile views of the joint from these two points would obviously differ somewhat, and an account is given here of an investigation undertaken with three objects:—

Fig. 4.—Right condyle with wire and spurs. Viewed from above and slightly laterally.

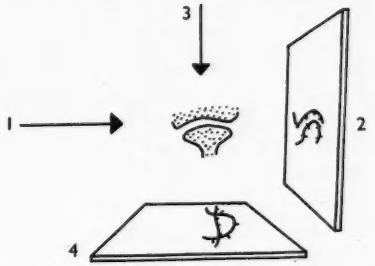

Fig. 5.—1, Direction of X-ray beam for pre- or post-auricular approach; 2, Corresponding position of cassette; 3, Direction of beam for downward view; 4, Corresponding position of cassette.

a. To compare the general features of the radiographs produced by two representative techniques.

b. To find out which bony structures are responsible for the radiographic picture in each technique.

c. To determine that part of the radiological joint space which most closely represents the anatomical space.

METHOD

Both means of radiological approach have their supporters, and it was decided to adopt for the purposes of this investigation two techniques which broadly represented the two schools of thought. The entry points for the central ray which were used were accordingly those suggested by Riesner (1936), and Lindblom (1936). The actual measurements are:—

Pre-auricular technique (Riesner's figures)

5·1 cm. above the external auditory meatus.

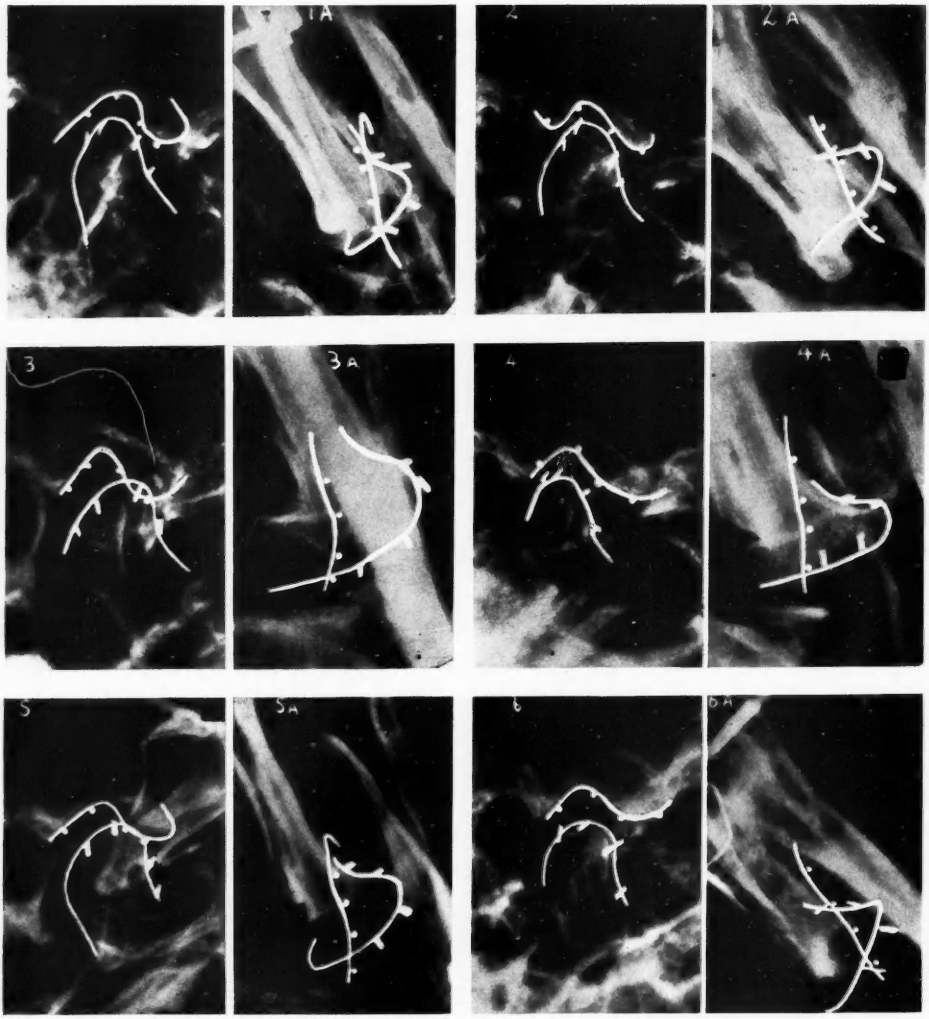

Fig. 6.—Radiographs of temporomandibular joints of six skulls taken by the pre-auricular technique. The outlines of the wires and markers have been accentuated. Nos. 1–6, Normal views; Nos. 1A–6A, Downward views.

1·3 cm. in front of the external auditory meatus.

Post-auricular technique (Lindblom's figures)

6·0 cm. above the external auditory meatus.

2·0 cm. behind the external auditory meatus.

Pre-auricular Technique.—A dry skull with a practically full dentition was fitted with brass locking strips to immobilize the mandible with the teeth together in the normal closed position (*Fig.* 2). To increase solidity a distance piece made of self-curing acrylic was fitted to the left temporomandibular joint. This skull was mounted on a table and orientated in the Frankfort plane. The table was fitted with spirit levels to ensure consistency of this orientation. To maintain a constant tube-skull relationship for the pre-auricular technique, the legs of the table were adapted to fit over screws sunk in the floor of the X-ray room, and the tube was positioned by means of the horizontal and vertical scales provided on the X-ray machine, together with an additional pointer registering on a wall scale to locate the carrying-arm.

Fig. 7.—Radiograph of joint in which wires have been placed for pre-auricular technique, but tube positioned as for post-auricular technique.

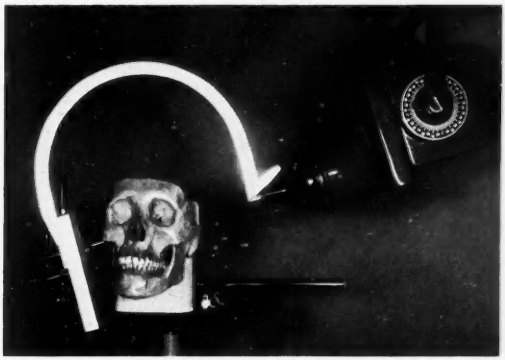

Fig. 8.—Skull, tube, and Lindblom apparatus.

Using the entry point already described, a radiograph was made of the right temporomandibular joint. Soft brass ligature wire was then adapted to the bony articulating surfaces of this joint. By trial and error, these wires were moved about and radiographs made until the shadows of the wires coincided with the radiographic outlines of the joint surfaces. Small ball-bearings were attached to the upper wire at regular intervals, and short lengths of thicker wire to the lower wire (*Figs.* 3, 4), and a further radiograph taken. The wires appeared in this X-ray to be one vertically above the other. However, it was obvious from the positions of the wires on the skull that this appearance was false. Accordingly, a downward X-ray was taken to show their true relationship in plan (*Fig.* 5).

The intersections of the wires seen in this last radiograph therefore represent the only parts of the joint outline which actually lie one above the other. All other points show considerable lateral displacement.

Using this technique, six skulls were examined radiographically. It was found that sufficient immobilization of the mandibles could be obtained by using four wires holding the mandible to the maxilla, with an acrylic distance-piece in the left temporomandibular joint of each skull. The radiographs are seen in *Fig.* 6, and inspection of No. 1 and No. 1A will show that by using the ball-bearings and spur-wires as markers, the intersections of the wires seen in No. 1A can be related to the outlines seen in No. 1. The anterior intersection occurs in the region of the second ball-bearing and the first spur-wire. A line joining these points on No. 1 is from a point on the eminentia articularis to low down on the

anterior edge of the condyle neck. The posterior intersection occurs at the last ball-bearing and the last spur-wire, well in the posterior part of the joint space. It is clear that at both intersections the distortion effects are minimal. However, the anterior intersection would seem to be almost beyond the confines of the normal joint space, and therefore of little value in assessing its dimensions; whereas the posterior intersection, being within the joint space, would appear to have greater value for this purpose.

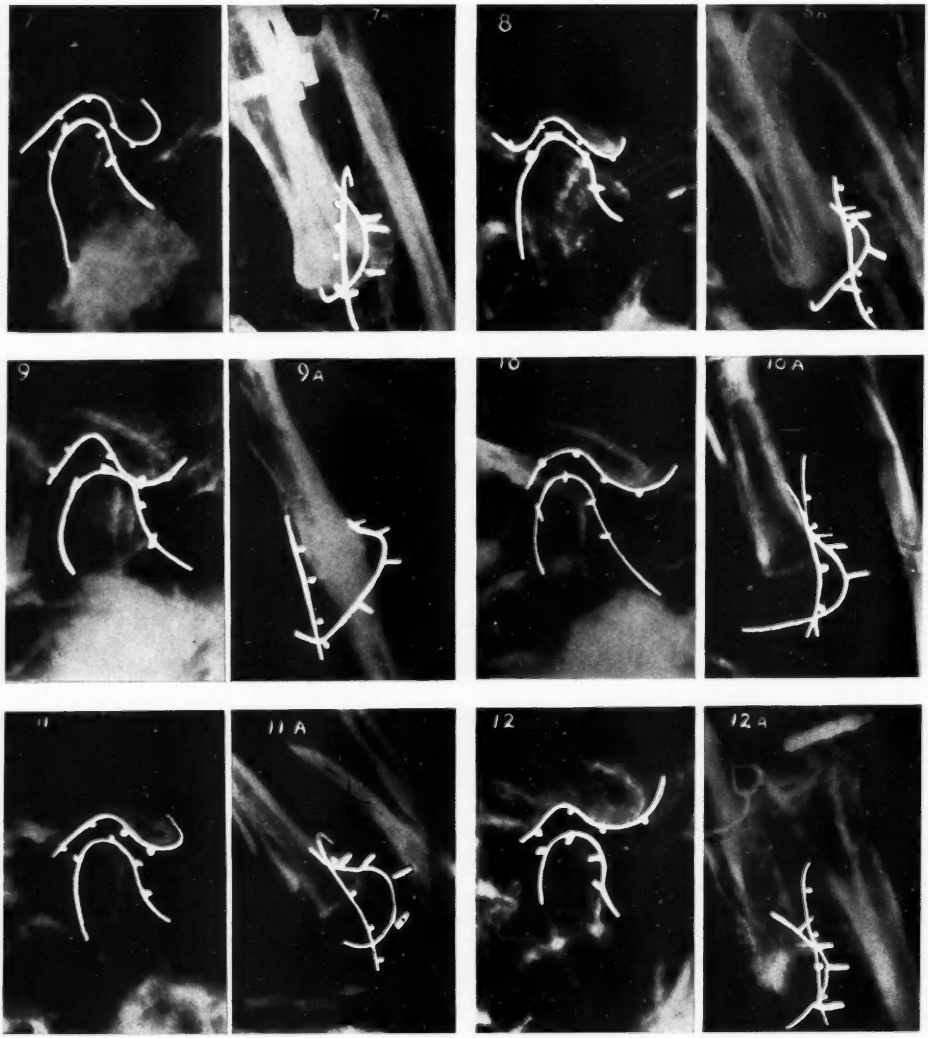

Fig. 9.—Radiographs of same six skulls taken by post-auricular technique. Nos. 7–12, Normal views; Nos. 7A–12A, Downward views.

Post-auricular Technique.—The next stage in the investigations was to repeat, using the post-auricular technique, the same series of radiographs on the same six skulls. It is obvious that from a different tube position a different condyle profile will be obtained.

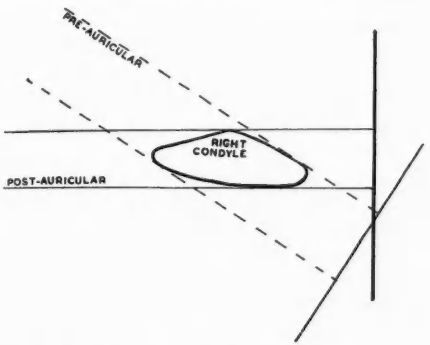

Fig. 10.—Diagram of relation of central ray to condyle axis.

Fig. 7 shows X-rays of a joint in which the wires have been placed in the positions outlining the joint space when the pre-auricular technique is used, and the radiograph taken from the post-auricular position. The difference in condyle profiles is considerable.

The selected technique in this second series was that suggested by Lindblom, and through the kindness of Dr. Lindblom it was possible to use the tube-positioning device designed by him. It was found that this could be attached to the original skull table, and as the apparatus is expressly designed to maintain a constant tube/patient relationship, it was unnecessary to use any further locating methods (*Fig.* 8).

The series of radiographs obtained by this post-auricular technique are shown in *Fig.* 9.

CONCLUSIONS

1. The nearest approach to an anatomically correct radiographic representation of the temporomandibular joint would be made with the central ray directed along the condyle axis. As this is not at present possible with normal X-ray equipment, two alternative techniques are in use. The essential difference between the techniques lies in the relation of the central ray to the condyle axis (*Fig.* 10). The pre-auricular entry point will obviously give a condyle outline which is broader than that given by the post-auricular approach; in fact, the whole joint becomes elongated antero-

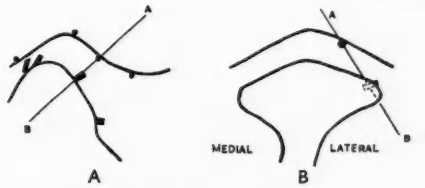

Fig. 11.—A, Diagram of X-ray No. 4 from *Fig.* 6. B, Vertical relationship of points on line A–B.

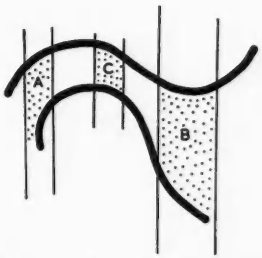

Fig. 12.—Zones of maximum and minimum distortion obtained by averaging the results of radiographs of six skulls made by the pre-auricular technique (*see Fig.* 6). In zones A and B, distortion is minimal. In zone C it reaches its maximum, the lateral displacement being one-third of the average condyle width in the series examined.

posteriorly if the former method is used. This may give a false impression of shallowness of the glenoid cavity, and an apparent flattening of the eminence. Briefly, the pictures produced by these two techniques will be different, and embody different distortions, but the post-auricular method will give the more anatomically correct outline.

2. Both techniques will produce a picture which can be recognized as that of a temporomandibular joint, but this picture will be of something far removed from a flat anatomical "slice".

The upper articulating surface shown on a radiograph made by either technique is produced by bony structures that lie roughly

along the junction of the middle and lateral thirds of the joint. The condyle outline is produced by structures forming a line starting close to the medial pole of the condyle and extending to its lateral pole.

3. When attempts are made to assess the dimensions of the joint space, as in treatment of various joint or occlusal disorders, the region most commonly used is between the anterosuperior slope of the condyle and the posterior slope of the eminence. *Fig.* 6, X-ray No. 4, shows this area to be between the second ball-bearing and the second condyle marker. X-ray No. 4A, the downward view, shows these two points to be widely spaced laterally. *Fig.* 11 shows diagrammatically the vertical relationship of these points. The line joining them is far from being parallel with the film, and therefore distortion at this point will be considerable. Inspection of the other X-rays will show that, in general, distortion is always considerable in the area under discussion.

4. In the downward views, the X-rays show that the posterior intersection of the wires occurs in the posterior part of the joint space, whichever technique is used. Therefore, any deductions regarding joint space should be made only in this region, and any measurements should be made only in a vertical direction. Obviously, such measurements can have but a comparative value only. To deduce from a single radiograph that the joint space is reduced would be absurd, for the radiological joint space depends on the technique used and the shape of the joint, any anatomical variations present either adding to or reducing the distortion produced by the technique. These anatomical variations may be considerable, and their occurrence may explain why a radiograph of a particular joint may be useless from one approach, but apparently acceptable from another. In this series, skull No. 3 had an abnormal condyle angulation; *Fig.* 6, No. 3, shows the X-ray obtained by a pre-auricular approach, and *Fig.* 9, No. 9, the post-auricular.

SUMMARY

An attempt has been made to demonstrate which structures are seen on temporomandibular joint radiographs taken by different techniques.

It has been shown that:—

a. Such a radiograph is far from being a flat "slice" through the joint.

b. The region which is most frequently used to deduce joint space dimensions and condyle position is unfortunately the region principally affected by distortion.

Acknowledgements.—We would like to thank Dr. Lindblom for the loan of a positioner, and for his interest and encouragement.

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CENTRAL HEALTH SERVICES COUNCIL

FLUORIDATION: "NO EVIDENCE OF HARM"

In his foreword to the *Report of the Central Health Services Council for the Year ended December* 31, 1955★, the Minister of Health, Mr. Robin Turton, describes as "a valuable discussion" the Council's report on fluoridation of domestic water supplies as a means of reducing dental decay. "All kinds of fears had been expressed and objections raised to the proposal", he says, "and the Council have helped to advance what I am satisfied is the right policy by recording their conclusion, and that of the Standing Medical Advisory Committee, that despite many years of observation and investigation there is no scientific or medical evidence available which suggests that there is any risk in drinking water containing fluoride in the low concentration proposed."

★ H.M. Stationery Office. Price 1*s.* 9*d.*

The Council discuss in detail suggestions of possible toxic effects from fluoridation. Apart from the effect of acute lethal dosage, which for adults is several thousand times the proposed fluoridation dose and for children several hundred, the effects of fluoride can be divided into those seen in high-grade industrial or natural fluorosis and the possible effects of artificial fluoridation of the order of 1·0 p.p.m., they state.

U.S. INVESTIGATIONS

A comparative study had been made of two areas in Texas, one with a natural fluoride content of 8 p.p.m. and the other with 0·5 p.p.m. In each over 100 individuals were studied who had lived in the area continuously for at least 15 years at the start of the study. They were carefully examined physically, radiologically, pathologically, and dentally first in 1943 and again in 1953, when the minimum exposure to these levels of fluoride was at least 25 years. Apart from dental mottling, the only statistically significant differences between the two areas was a slightly higher rate of cardiovascular abnormalities in the low fluoride areas and some unimportant changes in the blood-picture. Regarding criticism that the numbers were too small to show up differences unless these were very marked indeed, the Council point out that exposure to fluoride was so much higher than that entailed in artificial fluoridation that anything to be expected at 1 p.p.m. should have been shown greatly magnified at 8 p.p.m. "The fact that there were no relevant differences than dental mottling seems to justify the conclusion that no significant changes in health are seen after 25 years' exposure to this very high level of fluoride."

Another study in the U.S.A. had shown no difference in the mortality from all causes and from heart disease, intracranial lesions, nephritis, or cirrhosis of the liver in 64 cities in 16 States, half with a high and half with a low fluoride water supply.

It was sometimes suggested that the fluoride which is added to water supplies is not the same as that occurring naturally. Apart from the fact that the active particle is the fluoride ion, which is the same from any source, all "artificial" fluorides are prepared from naturally occurring minerals. The studies on American fluoridation projects showed that the artificial substance behaved in exactly the same way as the natural one.

The Council mention that dental caries affects 98 per cent of the population and even at 5 years of age children already have, on average, 5–6 defective teeth. It had never been suggested that fluoridation was the only means of preventing caries, but so far it has proved the most effective.

ABSTRACTS FROM OTHER JOURNALS

Clinical Evaluation of Results in Supervoltage X-ray Therapy

As is well known, the treatment of malignant disease can be most complex and difficult. The apparatus for producing high-energy radiation at Sheffield is a 2-million-volt Van de Graaff generator housed in the David Morrison Research Department. The author, in evaluating results of treatment carried out with this apparatus, makes the following observations re conditions treated in the mouth. High doses could be delivered to the lesion without causing necrosis of upper or lower jaw when the tumour was encroaching on bone, dryness of the mouth was more easily avoided, and skin reactions were practically non-existent. Advanced cases were treated by, first, treating more localized lesions with interstitial radium, and in some cases both supervoltage X-ray therapy and radium were used. Since installing this apparatus very difficult cases which would previously have been considered beyond palliation were able to be treated with remarkably good results.—BLOOMFIELD, G. W. (1956), *J. Fac. Radiol., Lond.*, **7**, 260.

The Effect of Estrogenic Hormone on the Periodontium of White Mice

Weekly subcutaneous injections of 600 rat units of estradiol benzoate in 8 young adult white mice for periods of 5 and 10 weeks respectively resulted in increased endosteal bone formation in the alveolar bone.

Over the 5-week period there was an increased cellularity of the periodontal membrane, but at the end of 10 weeks the cellularity was reduced and there was also a diminution in the well-formed collagen bundles and an inhibition of bone formation along the periosteal surfaces of the alveolar bone.

It should be noted that this hormonal therapy was given to animals without any initial deficiency.—SHKLAR, G., and GLICKMAN, I. (1956), *J. Periodont.*, **27**, 16.

Effect of Antiformin on Gingival Tissues

Eleven healthy gingival crevices in a young monkey were subjected to antiformin treatment.

Histologic examination revealed a complete necrosis of the epithelium and part of the connective tissue after 2 hours. This necrotic tissue was mostly removed after 16 hours, and healing was well advanced after 3 days, being nearly completed after 9 to 11 days. The inflammatory response was slight and no pocket deepening was observed.

It is concluded that antiformin is not a specific epithelial solvent, that irreparable damage should not be expected, and that subsequent curettage is unnecessary.—JOHNSON, R. E., and WAERHAUG, J. (1956), *J. Periodont*, **27**, 24.

The Management of the Alveolar Bone in the Treatment of the Periodontal Pocket

The need for limited removal of marginal alveolar bone is considered and analysed as a result of clinical and histological studies.

It is concluded that pocket elimination without bone removal is preferable, but bone removal is desirable when an intrabony pocket is present, and removal of bone does not entail the sacrifice of useful bone in respect of the affected or adjacent teeth; in intrabony pockets on proximal surfaces when the removal of bone is indispensable to elimination of the pocket; in simple pockets where there is marked difference in the height of the crestal bone, and in bifurcation or trifurcation involvement, to make cleansing of the intradicular space possible.—CARRANZA, F. A., and CARRANZA, F. A., jun. (1956), *J. Periodont.*, **27**, 29.

A Few Aids to Endodontic Practice

The author describes a few aids which he has found useful in endodontic practice, as it saves time and motion. Under this heading the following aids are described: (1) Sterilization of the field of operation; (2) Elimination of the odour of foul air from the compressed-air line; (3) Making a rubber dam marker; (4) Making a tray for rubber dam clamps; (5) A sponge rubber thumb moistener; (6) Contra-angle long-shank burs; (7) Glass bead sterilizer; (8) Reduction of processing time for X-ray films; (9) Drying root canals; (10) Use of root reamers; (11) Sterilizing gutta-percha points.—GROSSMAN, L. I. (1956), *Oral Surg.*, **9**, 305.

Oral Microbiology

The author gives the following reasons for normal oral defences against bacterial invasion:—

1. A heavy epithelial barrier in intact normal mucous membrane.
2. Excellent blood-supply to the gingival tissues.
3. Cleansing effect of mastication, and constant motion of tongue, lips, and cheeks.
4. Action of swallowing.
5. Action of saliva-flushing, buffer acids, enzymes.
6. Antibiotic effect of certain oral bacteria.
7. Anatomy of the oral cavity.

When these defences are in normal function the oral tissues are healthy, but when they are interfered with by inflammation resulting from calculus, defective filling margins, etc., invasion of tissues by oral bacteria will occur.—HINE, M. K. (1956), *Oral Surg.*, **9**, 316.

BOOK REVIEWS

GRUNDRISS DER PHARMAKOLOGIE FÜR ZAHNÄRZTE UND FÜR STUDIERENDE DER ZAHNHEILKUNDE. By T. GORDONOFF. Pp. 307. 1956. Basel: Benno Schwabe. (No British price stated.)

THIS text-book covers the subject clearly and straightforwardly. Most of the material is similar to what might appear in an English work, though a few agents are described which are unfamiliar. Except for those who read German easily or who wish to practise using the language, there are no obvious advantages over similar works in English for medical or dental practitioners. M. W.

APPLIED ORTHODONTICS. By JAMES DAVID MCCOY, M.S., D.D.S., F.A.C.D., Formerly Professor of Orthodontics in the School of Dentistry, University of Southern California, Los Angeles, in collaboration with EARL EMANUEL SHEPARD, D.D.S., F.A.C.D., Professor of Orthodontics in the School of Dentistry, Washington University, St. Louis, Mo. Second edition. $9\frac{1}{8} \times 6\frac{1}{8}$ in. Pp. 336, with 212 illustrations and 9 plates. 1956. London: Henry Kimpton. 56s.

THAT this book has reached its seventh edition is a measure of its popularity and usefulness to American students, for whom it is intended as an introduction to orthodontics.

Throughout the book emphasis is placed on the relationship of form to function. The authors consider the teeth to be "important functional units where malpositions prior to treatment are simply an indication of malformation of their osseous supporting structures". They go on to suggest that forces applied to the teeth during orthodontic treatment will produce alterations of form, size, and position of the dental arches and jaws. In the chapters on treatment it is clear that the authors are convinced that growth changes occur as soon as normal function can be achieved. In view of this it is surprising that no mention is made of functional appliance therapy, although due emphasis is given to Rogers' muscle exercises.

The cases are classified by Simon's method (using gnathostatic models), and the results assessed in conjunction with photostatic profile pictures. Cephalometric X rays are briefly mentioned, but the authors do not seemingly attach much importance to them.

The book is well produced and the illustrations are plentiful and helpful. J. S. R.

KRONFELD'S HISTOPATHOLOGY OF THE TEETH AND THEIR SURROUNDING STRUCTURES. Fourth edition, thoroughly revised and edited by PAUL E. BOYLE, D.M.D., University of Pennsylvania. $9\frac{1}{4} \times 6\frac{1}{8}$ in. Pp. 535, with 497 illustrations and 2 coloured plates. 1955. London: Henry Kimpton. 70s.

WHAT is there left to say about this excellent book now in its fourth edition! For its clear exposition of dental histopathology in such an easily readable form it should rank as the bible of the student and the reference book of every practitioner.

The layout is much the same as in previous editions and in fact most of the text remains unchanged. A number of illustrations have been added, including some very interesting ones of tissues seen with the electron microscope—a sign of the times! It is, however, difficult to imagine the reason for adding two colour plates, for the colour is of poor quality and the detail of the pictures is lost; black and white would have been better and would no doubt have helped to keep the price down, which incidentally has more than doubled since the second edition.

Where appropriate the text has been well revised and many new references are quoted; the occasional word however "dates" the origin of the text, as seen when "recent experiments" refers to work published in 1936–37. These are minor points which hardly deserve mention and indeed it seems superfluous to review this book at all since it is inconceivable that anyone could have qualified or could be contemplating qualifying without having read it. J. R. G.

SOCIETY NOTES

R.A.F. MEDICAL AND DENTAL BRANCHES' 26th ANNUAL DINNER

The annual dinner of the R.A.F. Medical and Dental Branches will be held on Friday, November 16, 1956, at the Royal College of Surgeons, Lincoln's Inn Fields, W.C.2, at 7 p.m. for 7.30 p.m.

The cost of the tickets will be 30s.

Evening dress or dinner jackets, with decorations, will be worn.

Past and present officers of the Medical, Dental, and Medical Technician Branches are eligible to attend, but, as the number of tickets is limited, application should be made as soon as possible to: The Honorary Secretary and Treasurer, R.A.F. Medical and Dental Services Dinner Fund, Air Ministry (M.A.3), 2–8 Richmond Terrace, Whitehall, London, S.W.1.

THE INSTITUTE OF BRITISH SURGICAL TECHNICIANS (INC.) (DENTAL SECTION)

A lecture will be given under the auspices of the Dental Section of the Institute of British Surgical Technicians (Midland Area) on "Orthodontics: Removable Appliances", by Mr. G. C. Dickson, B.Ch.D., F.D.S. R.C.S., D.Orth.R.C.S., Orthodontic Consultant to the Birmingham Group of Hospitals on Thursday, October 25, 1956, at 7.30 p.m. in the Lecture Theatre of the General Hospital, Steelhouse Lane, Birmingham. Tickets are obtainable on application with stamped addressed envelope to the Area Secretary, Mr. J. Harcourt, L.I.B.S.T., 8, Hillside Road, Erdington, Birmingham, 23.

COURSES FOR DENTAL TECHNICIANS

Dental Technicians' Committee,
Eastman Dental Hospital,
Gray's Inn Road, London, W.C.1

Evening Courses for Dental Technicians in Crown and Bridgework, Orthodontics, and Full and Partial Dentures, including Immediates and Chrome Cobalt, will be held, commencing in October, 1956. Each course will consist of twelve sessions, which will be held fortnightly. The courses will be of an advanced nature and are primarily intended for adult technicians.

Further particulars and application forms, which must be returned on or before Sept. 10, 1956, may be obtained from the Honorary Secretary, Dental Technicians' Committee, Eastman Dental Hospital, Gray's Inn Road, London, W.C.1.

EXAMINATION RESULTS

ROYAL COLLEGE OF SURGEONS OF ENGLAND

July, 1956

Fellowship in Dental Surgery.—The Board of Examiners reported to the Council that 37 candidates presented themselves for the Final Examination for the Fellowship in Dental Surgery, 9 of whom acquitted themselves satisfactorily. One of the successful candidates has not yet complied with the Regulations.

The following are the names of the 8 candidates who are therefore entitled, subject to the approval of the Council, to the Diploma of Fellow in Dental Surgery:—

Cowell, C. R.; Greive, J. H.; Kirkness, G. D.; Kohler, W. W.; Lee, F. M. S.; Picton, D. C. A.; Samarasinghe, I. L. P.; Todes, C. J.

UNIVERSITY OF EDINBURGH

July, 1956

Degree of Bachelor of Dental Surgery:—

Armitage, Jean Elizabeth; Armitage, J. S.; Biggin, D. R.; Campbell, I. J.; Davies, D. B.; Hitti, E. D.; Kjelland, C. H.; Macdonald, J.; McKendrick, A. J. W.; Simpson, W.; Smith, D. H.; Solomon, G. R.; Thom, W. M.; Thomson, N. P.; Tyson, K. W.; van der Merwe, H. R. A.; Willacy, R. A. W.

NEWTON HEATH TECHNICAL COLLEGE

City and Guilds of London Examinations for Dental Technicians:—

Intermediate: Beckett, A. N.; Pearson, J.; Seal, S. G.
Final: Ball, D. H.; Baron, B.; Butterworth, R.; Disley, J. R.; Dyson, G.; Nottingham, A.; Ward, L. B.
Advanced Orthodontics: Hewitt, C. L., L.I.B.S.T.

Dentition

A fixed space maintainer made of stainless steel wire is described. The only apparatus needed for its construction is a small pair of pliers, and it is quickly made in the mouth. With slight modification it can also be adapted to regain space already lost.—SANNERUD, O. R., *J. Dent. Child.*, **22**, 175.